

Amendments to the Claims

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (Currently Amended) A method of defining a storage format in multiple data storage devices, each data storage device having a plurality of storage media and a plurality of corresponding data transducer heads, each ~~transducer~~ head for recording on and playback of information from a corresponding storage media ~~medium~~ in multiple
5 zones, the method comprising the steps of:
- (a) (1) for a sample number of said data storage devices, measuring a performance of each head in the sample number of said data storage devices at one or more read/write frequencies per zone, and
- (2) for said multiple data storage devices, based on said performance
10 measurements, jointly ~~jointly~~ selecting a group of read/write frequencies, two or more read/write frequencies for each zone, and allocating one or more of the heads in each of the multiple data storage devices to each frequency in said group of frequencies per zone; and
- (b) in each of said multiple data storage devices, assigning one of said
15 frequencies to each head per zone, based on a capability of that head.
2. (Currently Amended) The method of claim 1, wherein in step (a)(1) measuring a performance of each head further includes the step ~~steps~~ of measuring a record/playback performance of that head at one or more read/write frequencies.

3. (Currently Amended) The method of claim 1, wherein in step (a)(1) measuring a performance of each head further includes the ~~step~~ steps-of measuring a record/playback performance of that head at multiple storage media ~~medium~~-locations.

4. (Currently Amended) The method of claim 1, wherein in step (a)(1) measuring a performance of each head further includes the ~~step~~ steps-of measuring a record/playback performance of that head according to a performance metric at different frequencies.

5. (Currently Amended) The method of claim 4, wherein said performance metric includes at least one of on-track symbol error rate ~~on-track~~, off-track symbol error rate ~~off-track~~, on-track mean square ~~squared~~-error ~~on-track~~, and off-track mean square ~~squared~~-error ~~off-track~~.

6. (Currently Amended) The method of claim 1, wherein step (a) is performed in a storage format design process and step (b) is performed in a test process.

7. (Currently Amended) The method of claim 6, wherein the storage format design process is part of a data storage device design phase and the test process is part of a data storage device manufacturing phase.

8. (Currently Amended) The method of claim 1, wherein step (a)(1) further includes the step steps-of calibrating each of said multiple data storage devices for each of said frequencies.

9. (Currently Amended) The method of claim 1, wherein step (a)(2) further includes the step steps-of jointly selecting said frequencies and allocating said heads to said frequencies, to satisfy a specified constraint.

10. (Currently Amended) The method of claim 9, wherein:

step (a)(1) further includes the steps of, for each of said sample number of said data storage devices:

5 selecting a performance metric for the heads in that data storage device for each zone; and

measuring a performance of each head at different frequencies per zone based on said metric; and

step (a)(2) further includes the step steps-of, for the multiple data storage devices:

10 based on said performance measurements, for each zone allocating an integral number of said heads to each of said frequencies for that zone to satisfy the specified constraint.

11. (Currently Amended) The method of claim 10, wherein in step (a)(2) allocating said heads to said frequencies per zone further includes the step of, steps of:

for each zone, based on the performance of the heads in a plurality of zones, allocating an integral number of said heads to each of said frequencies for that zone to satisfy said
5 constraint for said multiple data storage devices.

12. (Currently Amended) The method of claim 10, wherein step (a)(2) further includes the steps of:

based on said performance measurements, generating record/playback frequency capability distributions of the heads in the sample number of said data storage
5 devices, disk drives, at each zone for a target performance metric, and

based on said distributions, allocating an integral number of said heads to each of said frequencies for that zone to satisfy said constraint for said multiple data storage devices.

13. (Original) The method of claim 9, wherein said constraint comprises providing a required data storage capacity for each of said multiple data storage devices.

14. (Previously Presented) The method of claim 9, wherein said constraint comprises providing a required data storage device yield for said multiple data storage devices.

15. (Currently Amended) The method of claim 9, wherein said constraint comprises maximizing a the data storage device yield for the multiple data storage

devices while providing a specified data storage device capacity for ~~of~~ the multiple data storage devices.

16. (Currently Amended) The method of claim 9, wherein said constraint comprises maximizing a ~~the~~ data storage capacity for each of the multiple data storage devices while providing a specified data storage device yield for the multiple data storage devices.

17. (Currently Amended) A method of defining a storage format in multiple data storage devices, each data storage device having a plurality of storage media and a plurality of corresponding data transducer heads, each ~~transducer~~ head for recording on and playback of information from a corresponding storage media ~~medium~~ in multiple zones, the method comprising the steps of:

(a) (1) for a sample number of said data storage devices, measuring a performance of each head in the sample number of said data storage devices at one or more read/write frequencies per zone, and based on said performance measurements, generating performance distributions of the heads in said sample number of said data storage devices, at each zone for a target performance metric, and

(2) for said multiple data storage devices, based on said performance distributions, jointly ~~jointly~~ selecting a group of read/write frequencies, two or more read/write frequencies for each zone, and allocating one or more of the heads in each of the multiple data storage devices to each frequency in said group of frequencies per zone; and

(b) in each of said multiple data storage devices, assigning one of said frequencies to each head per zone, based on a capability of that head.

18. (Currently Amended) The method of claim 17, wherein generating said distributions further includes the steps of:

estimating a record/playback frequency capability of each head based on said performance measurements; ~~measurements~~, and

5 generating record/playback frequency capability distributions of the heads at each zone for said a-target performance metric based on said estimated record/playback frequency capabilities of the heads.

19. (Currently Amended) The method of claim 17, wherein the ~~step~~ steps of generating said distributions is performed in a post-processing phase.

20. (Currently Amended) The method of claim 17, wherein generating said distributions includes the ~~step of~~ steps of generating record/playback frequency capability distributions of the heads based on said performance measurements at said a target performance metric for the heads in said sample number of said data storage devices.

21. (Currently Amended) The method of claim 17, wherein in step (a)(2) selecting said group of frequencies further includes the ~~step~~ steps of selecting said group of frequencies to satisfy a specified constraint.

22. (Currently Amended) The method of claim 17, wherein said performance metric includes at least one of on-track symbol error rate ~~on-track~~, off-track symbol error rate ~~off-track~~, on-track mean square ~~squared-error-on-track~~, and off-track mean square ~~squared-error-off-track~~.

23. (Currently Amended) A method of defining a storage format in multiple data storage devices, each data storage device having a plurality of storage media and a plurality of corresponding data transducer heads, each ~~transducer~~ head for recording on and playback of information from a corresponding storage media ~~medium~~ in multiple
5 zones, the method comprising the steps of:

(a) (1) for a sample number of said data storage devices, measuring a performance of each head in the sample number of said data storage devices at one or more read/write frequencies per zone, and

(2) for said multiple data storage devices, based on said performance
10 measurements, jointly ~~jointly~~ selecting a group of read/write frequencies, two or more read/write frequencies for each zone, and for each zone allocating an integral number of said heads to each of said frequencies for that zone to satisfy a constraint; and

(b) in each of said multiple data storage devices, assigning one of said frequencies to each head per zone, based on a capability of that head and said allocation
15 of the heads.

24. (Currently Amended) The method of claim 23, wherein step (b) further includes the steps of, for each of said multiple data storage devices:

- (i) obtaining a record/playback performance of each head at a performance metric per zone at one of said read/write frequencies;
- 5 (ii) for each zone, ranking the heads from best to worst according to the performance metric; and
- (iii) assigning said allocated number of heads, according to the ranking, to one of said read/write frequencies.

25. (Currently Amended) The method of claim 24, further comprising the step steps-of:

repeating steps (i)-(iii) for the remaining heads at the other read/write frequencies.

26. (Original) The method of claim 24, wherein steps (i)-(iii) are repeated for each of said frequencies, starting from the highest frequency to the lowest frequency.

27. (Currently Amended) The method of claim 24, wherein ~~wherein~~-step (ii) further includes the step ~~steps~~-of selecting said performance metric for the heads in that data storage device for each zone.

28. (Currently Amended) The method of claim 23, wherein for each head in said multiple data storage devices, the same ~~said~~-number of said zones are on different storage media in each data storage device.

29. (Currently Amended) The method of claim 23, wherein for each head in said multiple data storage devices, the same said number of said zones are on the same storage media in each data storage device.

30. (Currently Amended) The method of claim 23, wherein in step (a)(2) said constraint specified criteria comprises providing a specified data storage capacity for each of the multiple data storage devices while maximizing a data storage device yield for the multiple data storage devices.

31. (Currently Amended) The method of claim 23, wherein in step (a)(2) said constraint specified criteria comprises maximizing a the data storage capacity for each of the multiple data storage devices while providing a specified data storage device yield for the multiple data storage devices.

32. (Currently Amended) The method of claim 23, wherein step (b) further includes the step ~~steps~~ of calibrating each data storage device for each frequency.

33. (Currently Amended) A method of defining a storage format in multiple data storage devices, each data storage device having a plurality of storage media and a plurality of corresponding data transducer heads, each ~~transducer~~ head for recording on and playback of information from a corresponding storage media ~~medium~~ in multiple
5 zones, the method comprising the steps of:

(a) (1) for a sample number of said data storage devices, measuring a performance of each head in the sample number of said data storage devices at one or more read/write frequencies per zone, and

10 (2) for said multiple data storage devices, based on said performance measurements, ~~jointly jointly~~ selecting a group of read/write frequencies, two or more read/write frequencies for each zone, and allocating one or more of the heads in each of the multiple data storage devices to each frequency in said group of frequencies per zone; and

15 (b) in each of said multiple data storage devices, assigning one of said frequencies to each head per zone, based on a capability of that head;

wherein in each of said multiple data storage devices:

said multiple zones on each storage media are arranged as concentric zones, each zone having an inner and an outer boundary at different radial locations on the storage media,

20 such that each storage media includes the same number of concentric zones as other storage media in that data storage device, and ~~such that~~ the boundaries of radially similarly situated zones on all the storage media in that data storage device are at the same radial locations.

34. (Original) The method of claim 33, wherein radially similarly situated zones on all the storage media include the same number of concentric tracks.

35. (Currently Amended) The method of claim 33, wherein at least a number of radially similarly situated zones on all the storage media include a different number of concentric tracks.

36. (Currently Amended) A method of defining a storage format in multiple data storage devices, each data storage device having a plurality of storage media and a plurality of corresponding data transducer heads, each ~~transducer~~ head for recording on and playback of information from a corresponding storage media ~~medium~~ in multiple
5 zones, the method comprising the steps of:

(a) (1) for a sample number of said data storage devices, measuring a performance of each head in the sample number of said data storage devices at one or more read/write frequencies per zone, and

(2) for said multiple data storage devices, based on said
10 performance measurements, jointly ~~jointly~~ selecting a group of read/write frequencies, two or more read/write frequencies for each zone, and allocating one or more of the heads in each of the multiple data storage devices to each frequency in said group of frequencies per zone; and

(b) in each of said multiple data storage devices, assigning one of said
15 frequencies to each head per zone, based on a capability of that head;

wherein in each of said multiple data storage devices:

said multiple zones on each storage media are arranged as concentric zones, each zone having an inner and an outer boundary at different radial locations on the storage media,

such that each storage media includes a sequence of concentric zones, and
~~such that~~ the boundaries of at least a number of sequentially similarly situated zones on
different storage media in that data storage device are at different radial locations.

37. (Original) The method of claim 36, wherein sequentially similarly situated
zones on all the storage media include the same number of concentric tracks.

38. (Currently Amended) The method of claim 36, wherein at least a number
of sequentially similarly situated zones on all the storage media include a different
number of concentric tracks.

39. (Currently Amended) A data storage device comprising a plurality of pairs
of storage media surfaces and transducer heads, each ~~transducer~~ head for recording on
and playback of information from a corresponding storage media surface ~~medium~~ in
multiple zones, and a controller that controls the heads for reading and writing data on the
5 storage media surfaces, the controller being programmed to write data in a storage format
defined by the steps including:

(a) (1) for a sample number of multiple data storage devices, measuring a
performance of each head in the sample number of said data storage devices at one or
more read/write frequencies per zone, and

10 (2) for said data storage device, based on said performance
measurements, jointly ~~jointly~~ selecting a group of read/write frequencies, two or more

read/write frequencies for each zone, and allocating one or more of the heads in said ~~that~~ data storage device to each frequency in said group of frequencies per zone; and

15 (b) in said data storage device, assigning one of said frequencies to each head per zone, based on a capability of that head, thereby defining said storage format.

40. (Currently Amended) The data storage device of claim 39, wherein in step (a)(1) measuring a performance of each head further includes the step ~~steps~~ of measuring a record/playback performance of that head according to a performance metric at different frequencies.

41. (Currently Amended) The data storage device of claim 39, wherein step (a) is performed in a data storage device design phase and step (b) is performed in a data storage device manufacturing phase.

42. (Currently Amended) The data storage device of claim 39, wherein step (a)(1) further includes the step ~~steps~~ of calibrating each of said multiple data storage devices for each of said frequencies.

43. (Currently Amended) The data storage device of claim 39, wherein step (a)(2) further includes the step ~~steps~~ of jointly selecting said frequencies and allocating said heads to said frequencies, to satisfy a specified constraint.

44. (Currently Amended) The data storage device of claim 43, wherein:

step (a)(1) further includes the steps of, for each of said sample number of said data storage devices:

5 selecting a performance metric for the heads in that data storage device for each zone; and

measuring a performance of each head at different frequencies per zone based on said metric; and

step (a)(2) further includes the step ~~steps~~ of, for the multiple data storage devices:

10 based on said performance measurements, for each zone allocating an integral number of said heads to each of said frequencies for that zone to satisfy the ~~specified~~ constraint.

45. (Currently Amended) The data storage device of claim 44, wherein in step (a)(2) allocating said heads to said frequencies per zone further includes the step of, ~~steps of~~ for each zone, based on the performance of the heads in a plurality of zones, allocating an integral number of said heads to each of said frequencies for that zone to satisfy said constraint for said multiple data storage devices.

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46. (Currently Amended) The data storage device of claim 44, wherein step (a)(2) further includes the steps of:

based on said performance measurements, generating record/playback frequency capability distributions of the heads in the sample number of said data storage devices, disk drives, at each zone for a target performance metric; metric, and

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based on said distributions, allocating an integral number of said heads to each of said frequencies for that zone to satisfy said constraint for said multiple data storage devices.

47. (Original) The data storage device of claim 43, 44, wherein said constraint comprises providing a required data storage capacity for each of said multiple data storage devices.

48. (Previously Presented) The data storage device of claim 43, wherein said constraint comprises providing a required data storage device yield for said multiple data storage devices.

49. (Currently Amended) The data storage device of claim 43, wherein said constraint comprises maximizing a the data storage device yield for the multiple data storage devices while providing a specified data storage device capacity for of the multiple data storage devices.

50. (Currently Amended) The data storage device of claim 43, wherein said constraint comprises maximizing a the data storage capacity for each of the multiple data

storage devices while providing a specified data storage device yield for the multiple data storage devices.

51. (Currently Amended) A data storage device comprising a plurality of pairs of storage media surfaces and transducer heads, each ~~transducer~~ head for recording on and playback of information from a corresponding storage media surface ~~medium~~ in multiple zones, and a controller that controls the heads for reading and writing data on the storage media surfaces, the controller being programmed to write data in a storage format defined by the steps including:

- (a) (1) for a sample number of multiple data storage devices, measuring a performance of each head in the sample number of said data storage devices at one or more read/write frequencies per zone, and based on said performance measurements, generating performance distributions of the heads in said sample number of said data storage devices, at each zone for a target performance metric, and
- (2) for the data storage device, based on said performance distributions, jointly ~~jointly~~ selecting a group of read/write frequencies, two or more read/write frequencies for each zone, and allocating one or more of the heads in each of the multiple data storage devices to each frequency in said group of frequencies per zone; and
- (b) in the data storage device, ~~devices~~, assigning one of said frequencies to each head per zone, based on a capability of that head.

52. (Currently Amended) The data storage device of claim 51, wherein generating said distributions further includes the steps of:

estimating a record/playback frequency capability of each head based on
said performance measurements; ~~measurements~~, and

5 generating record/playback frequency capability distributions of the heads
at each zone for said a-target performance metric based on said estimated record/playback
frequency capabilities of the heads.

53. (Currently Amended) The data storage device of claim 51 wherein the step
~~steps~~ of generating said distributions is performed in a post-processing phase.

54. (Currently Amended) The data storage device of claim 51, wherein
generating said distributions includes the step of ~~steps of~~ generating record/playback
frequency capability distributions of the heads based on said performance measurements
at said a-target performance metric for the heads in said sample number of said data
storage devices.

55. (Currently Amended) The data storage device of claim 51, wherein in step
(a)(2) selecting said group of frequencies further includes the step ~~steps~~ of selecting said
group of frequencies to satisfy a specified constraint.

56. (Currently Amended) A data storage device comprising a plurality of pairs
of storage media surfaces and transducer heads, each ~~transducer~~ head for recording on
and playback of information from a corresponding storage media surface ~~medium~~ in
multiple zones, and a controller that controls the heads for reading and writing data on the

5 storage media surfaces, the controller being programmed to write data in a storage format defined by the steps including:

(a) (1) for a sample number of multiple data storage devices, measuring a performance of each head in the sample number of said data storage devices at one or more read/write frequencies per zone, and

10 (2) for said data storage device, based on said performance measurements, ~~jointly jointly~~ selecting a group of read/write frequencies, two or more read/write frequencies for each zone, and for each zone allocating an integral number of said heads to each of said frequencies for that zone to satisfy a constraint; and

(b) in said data storage device, assigning one of said frequencies to each head
15 per zone, based on a capability of that head and said allocation of the heads.

57. (Currently Amended) The data storage device of claim 56, wherein step (b) further includes the steps of, for the data storage device:

(i) obtaining a record/playback performance of each head at a performance metric per zone at one of said read/write frequencies;

5 (ii) for each zone, ranking the heads from best to worst according to the performance metric; and

(iii) assigning said allocated number of heads, according to the ranking, to one of said read/write frequencies.

58. (Currently Amended) The data storage device of claim 57, wherein step (b) further comprises the step ~~steps~~ of:

repeating steps (i)-(iii) for the remaining heads at the other read/write frequencies.

59. (Currently Amended) The data storage device of claim 57, wherein step (b) further includes the ~~step~~ steps of selecting said performance metric for the heads in ~~the that~~ data storage device for each zone.

60. (Currently Amended) The data storage device of claim 56, wherein in step (a)(2) said ~~constraint specified criteria~~ comprises providing a specified data storage capacity for the multiple data storage devices while maximizing a data storage device yield for the multiple data storage devices.

61. (Currently Amended) The data storage device of claim 56, wherein in step (a)(2) said ~~constraint specified criteria~~ comprises maximizing ~~a the~~ data storage capacity for each of the multiple data storage devices while providing a specified data storage device yield for the multiple data storage devices.

62-64. (Cancelled)

65. (Currently Amended) A data storage device comprising a plurality of pairs of storage media surfaces and transducer heads, each ~~transducer~~ head for recording on and playback of information from a corresponding storage ~~media surface medium~~ media surface in multiple zones, and a controller that controls the heads for reading and writing data on the

5 storage media surfaces, the controller being programmed to write data in said multiple zones, wherein:

said multiple zones on each storage media are arranged as concentric zones, each zone having an inner and an outer boundary at different radial locations on the storage media,

10 such that each storage media includes a sequence of concentric zones, and
~~such that~~ the boundaries of at least a number of sequentially similarly situated zones on different storage media in the ~~that~~ data storage device are at different radial locations, wherein sequentially similarly situated zones on all the storage media include the same number of concentric tracks.

66-67. (Cancelled)